

Flies as vectors for bacterial and viral infections

The case for a potential transmission mechanism of Livestock-associated MRSA and African Swine Fever Virus

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Livestock-associated MRSA (LA-MRSA/MRSA CC398): Emergence in Denmark

- 2008-2016: Danish pig herds infected with LA-MRSA rose from 3-5% to 88%
- Simulation models unable to explain entire observed spread
- Thus: Other transmission pathways must be contributing as well

- Most human cases concern rural areas, but without direct contact to pigs (15% in 2020)

- MRSA bacteria can spread downwind from infected pig farm
- However: Spread pattern of human infections suggests more than just environmental spread

Stable-and house flies as (mechanical) vectors of pathogens

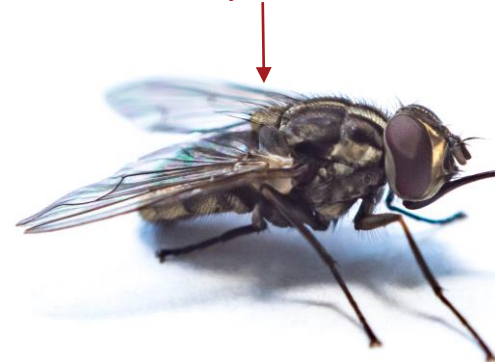
(*Stomoxys calcitrans* & *Musca domestica*)

- Known vectors to a wide variety of pathogens
- Foraging behaviour actively seeks out places on a pig that accommodate high levels of LA-MRSA bacteria
(i.e. skin, wounds & mucous membranes)
- Known to migrate between pig farms



Stable fly

Stomoxys calcitrans



House fly

Musca domestica



LA-MRSA prevalence over time experiment



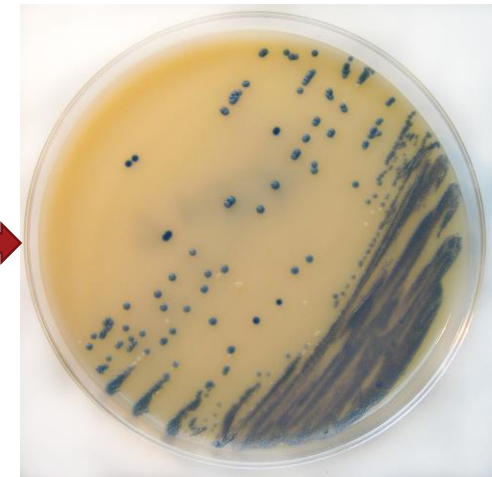
Step 1:
Catch flies



Step 2:
Subsample over
time

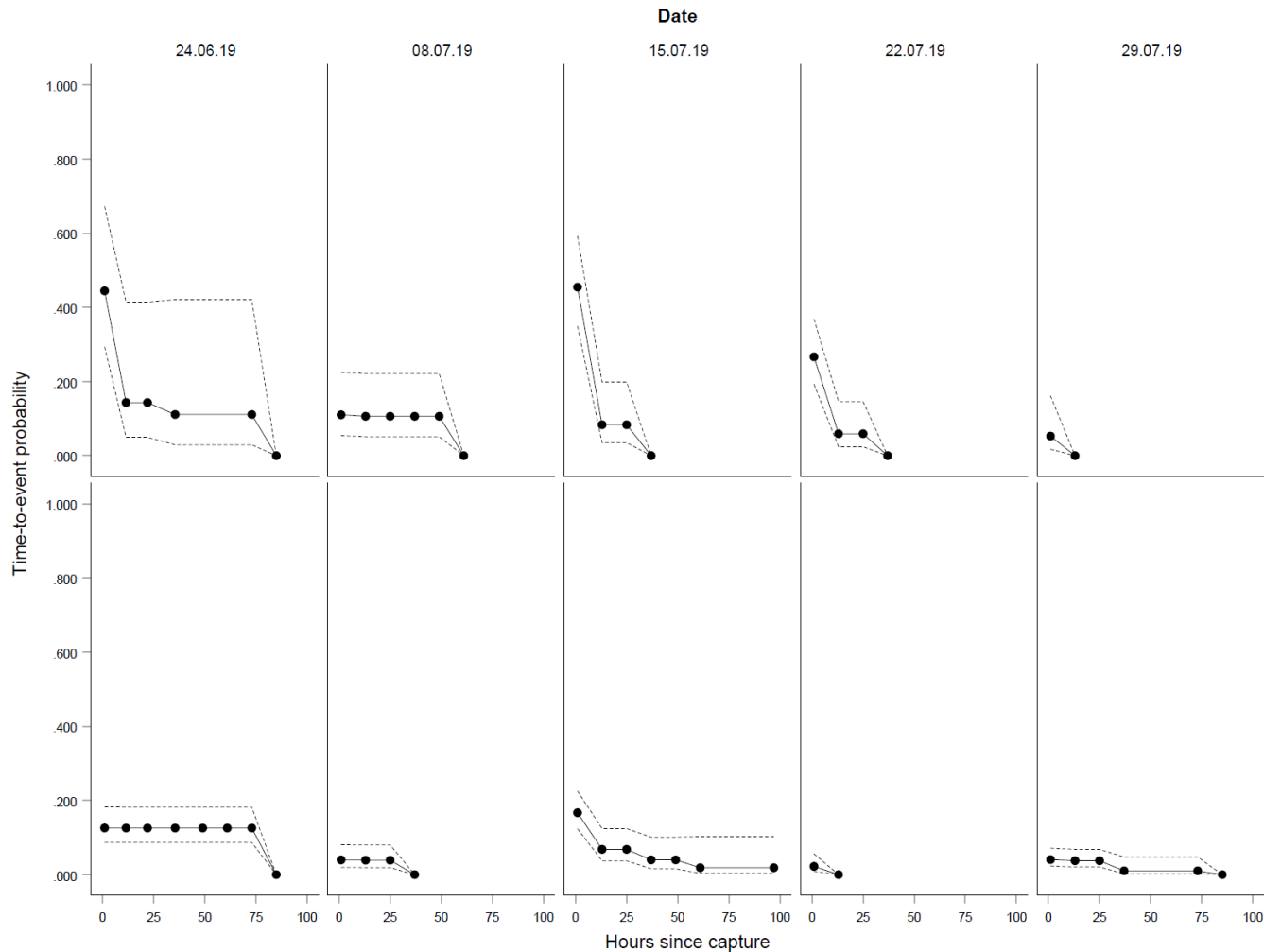


Step 3:
Cultivate any
present LA-MRSA
bacteria



Step 4:
Determine LA-
MRSA presence
and prevalence
over time

LA-MRSA survival rate

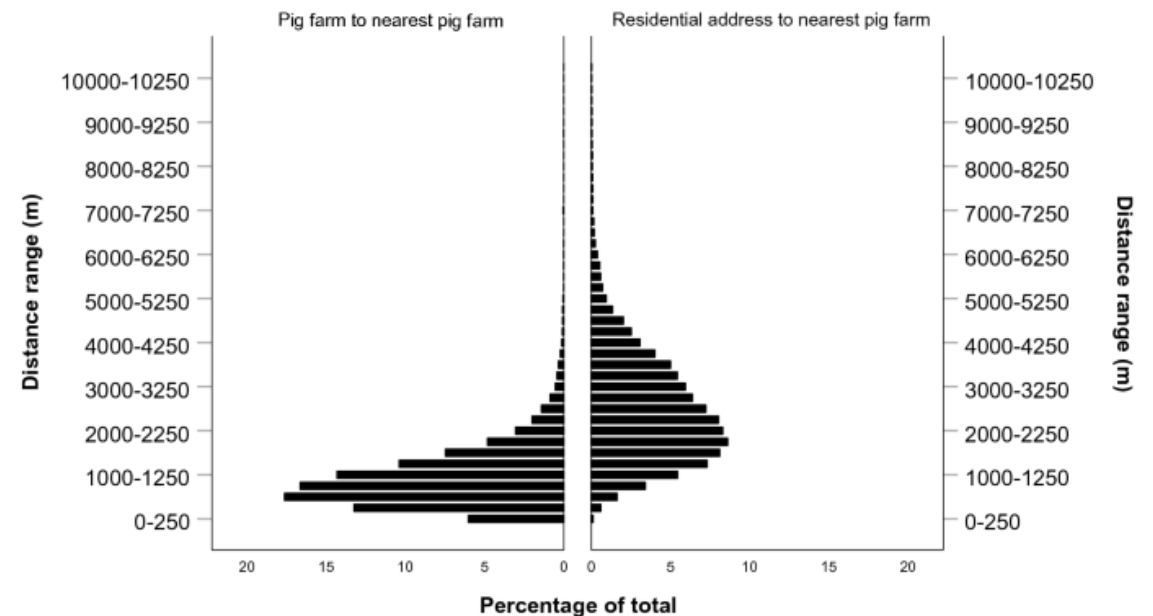


- LA-MRSA prevalence decreases of time
- Likelihood of a fly carrying LA-MRSA decreases over time
- Bacteria do not replicate
- Substantial decline within 24 hours
- No more LA-MRSA after ~96 hours

Dispersal distance estimates: implications for Denmark

“Dispersal potential = LA-MRSA “survival” + insect flight speed or distance”

- **Conclusion:** The vast majority of pig herds and residential addresses in Denmark are, temporally speaking, within potential range for a stable- or house fly to transport live LA-MRSA bacteria to.
- However: Further studies are needed to establish whether stable- or house flies can be considered viable mechanical vectors of LA-MRSA



LA-MRSA



ASFV



African Swine Fever Virus (ASFV) and insects

- Simulation models do not explain entire observed spread
- Outbreaks at pig farms peak in summer months
- Flying hematophagous insect could bypass current biosecurity measures
- Quantify the potential for hematophagous insect-borne transmission of ASFV
- Break it down into smaller quantifiable steps
- Model likelihood of this transmission mechanism occurring



Current ASFV work

- Lithuania:
 - Foreign bloodmeals entering high-biosecurity pig farms
 - Preliminary result: found horseflies carrying foreign blood (bovine) likely at least 2500m(!) away from the farm
 - Results later this year
- Romania:
 - Seasonal abundance of hematophagous insects
 - Biting rates wild boar/domestic pig
 - Results later this year



Further reading:

Livestock-associated MRSA survival on house flies (*Musca domestica*) and stable flies (*Stomoxys calcitrans*) after removal from a Danish pig farm

Jonno Jorn Stelder, Lene Jung Kjær, Lars Bogø Jensen, Anette Ella Boklund, Matt Denwood, Margrethe Carlsen & René Bødker

<https://www.nature.com/articles/s41598-021-83228-7>

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Spiller fluer en rolle i spredningen af husdyr-relateret MRSA (LA-MRSA) i Danmark?

Jonno Jorn Stelder

<https://dvt.ddd.dk/bladarkiv/2021/nr-05/spiller-fluer-en-rolle-i-spredningen-af-husdyr-relateret-mrsa-la-mrsa-i-danmark/>

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